California's Aerial Photography Inventory of Freeways

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In the Fall of 1960 and Spring of 1961 the Los Angeles area district and the San Francisco area district of the California Division of Highways were supplied with an aerial photographic inventory at a scale of 200 ft to 1 in. of most of the existing freeways in those areas. This initial inventory on 348 miles of freeways then existing in these two areas was of an experimental nature to determine whether large-scale aerial photography would be useful for traffic engineering applications such as studying accident prone locations, determining vehicle movement paths, and identifying signing problems.

• THE PHOTOGRAPHS in the Los Angeles area were taken between April 25 and May 12, 1960, and the material was accepted by the Division of Highways on August 18, 1960. The photographs in the San Francisco area were taken between December 22, 1960, and March 23, 1961, and accepted on May 18, 1961. In each case the photographs obtained were two sets of 9- by 18-in. contact prints on double-weight semi-matte paper at a nominal scale of 200 ft to 1 in., two sets of photography index maps, and all photographic negatives. Figure 1 is a typical contact print.

The work was done as two separate contracts. The contractors were supplied with 1:24,000 scale USGS topographic maps published on a quadrangle basis showing flight lines and areas to be photographed. The contracts required aerial vertical photography taken with a camera having a nominal focal length of 24 in. and a 9- by 18-in. negative size. The 18-in. axis oriented along the flight line gave ground area coverage 1,800 ft wide and 3,600 ft along the highway. Overlap in line of flight of at least 15 percent was specified.

At interchanges where ramp terminals were located more than 700 to 800 ft from the flight lines, additional photography coverage along the crossroads was obtained.

Total cost, excluding engineering by the Division of Highways, for the 348 miles photographed was $7,130.40 or $20.49 per mi.

The 9- by 18-in. aerial photographs have been enthusiastically accepted and are being used in a variety of ways. Uses include traffic engineering studies, research studies, design, planning, maintenance, project review, programming of improvements, and communications.

Traffic engineers use the photographs to study accident prone locations, to determine vehicle paths in relation to various geometric features, and to study signing problems. The photographs have also been used to determine the exact location to place pavement markings at interchanges and at intersection of ramps with surface streets, thus reducing the amount of field work normally required. Further, the photographs permit parking prohibition studies and studies regarding striping, signing, median barriers, illumination, and traffic control, with a minimum amount of field work and review. In addition, the photographs either eliminate or reduce the research ordinarily required into old plans, cross-sections, and records for accomplishing the previously mentioned traffic studies and for planning locations for traffic counting stations.

Paper sponsored by Committee on Photogrammetry and Aerial Surveys.

Figure 1. One inch equals 200 feet contact print.

The 9- by 18-in. contact prints have been reproduced in a variety of forms and scales to be used as exhibits in various reports. The untouched reproduction is used to show existing conditions. Proposed changes have been shown by delineating the recommended change in ink or colored pencil on the reproduced print.

The photographs contain sufficient details for making a convenient and accurate inventory of existing facilities and district planning departments have found them invaluable in planning and programming needed improvements. The photographs are more effective than maps in helping private citizens and technical staffs of local agencies identify properties and visualize improvements. The public in general, and especially property owners and developers seeking information, are favorably impressed by the fact that these photographs are available and by the efficient manner in which the engineer can communicate with the public when aided by the photographs. From the public relations standpoint, this is valuable.

The San Francisco area district office has utilized the photographs to produce base maps in planning an improvement to an existing freeway. This freeway is located in the City of San Jose on relatively level topography. A great deal of development has taken place along the right-of-way since the freeway was constructed so the initial construction plans of the highway were of little value for making a base map to plan the revisions required.

In cases such as this, it is customary to have topographic maps compiled photogrammetrically. Such mapping would have required several weeks. To expedite the preparation of the needed base maps and to reduce costs, the district prepared maps at a scale of 100 ft to 1 in. using the 200-ft to 1-in. scale photographs. Known distances between easily identified features along the freeway, such as ramp noses, bridges, and culverts, were used to determine the exact amount each photograph should be enlarged to produce the photographic base maps on sensitized polyester film. The amount of enlargement varied because photographic scale is a function of flight height, ground relief, and camera tilt. The resulting base maps, however, were reasonably close to the desired scale of 100 ft to 1 in. along the freeway, although scale in the transverse direction was not necessarily the same or uniform.

Although as the finished product was not as accurate as topographic maps which could have been compiled photogrammetrically, it was sufficiently accurate and detailed for the purpose of planning additional lanes required and for the preliminary design of modifications to the existing interchanges. The total time to produce the base maps (from photographs to the end product) was ten days.

The photographic inventory also has many useful applications in the maintenance field. The photographs help in analyzing drainage problems by locating existing facilities and spotting controls, and in determining corrective measures. They are used in discussing numerous field problems between office and field personnel. The aerial photographs eliminate need of specially prepared sketches to illustrate details during discussions.

In relinquishing old highways to local authorities and in drawing up maintenance agreements with local agencies, the photographs have been helpful in verifying details shown on plans or maps and in extending coverage beyond the limits of existing plans and maps. The photographs point up logical limits by showing such controls as fences, roads, curbs, drainage ways, landscaping limits, and other geographic, topographic, and physical features.

Another application by the maintenance department is in issuing permits for encroachments and for transit of extra-legal loads. The photographs expedite investigations and decision making on such applications by showing the degree and type of occupancy in the vicinity of the requested permit, and by showing other relevant factors such as driveways, traffic control devices, bridges, signs, and other restrictive controls.

Researchers conducting studies on speed, capacity, and safety have found the photographs useful. In a research project regarding wrong-way driving incidents on freeways, the aerial photographs were used in reconstructing the event and the path traversed by the vehicle to determine points of wrong-way entry.

Another application being investigated is the use of photographs to pinpoint the

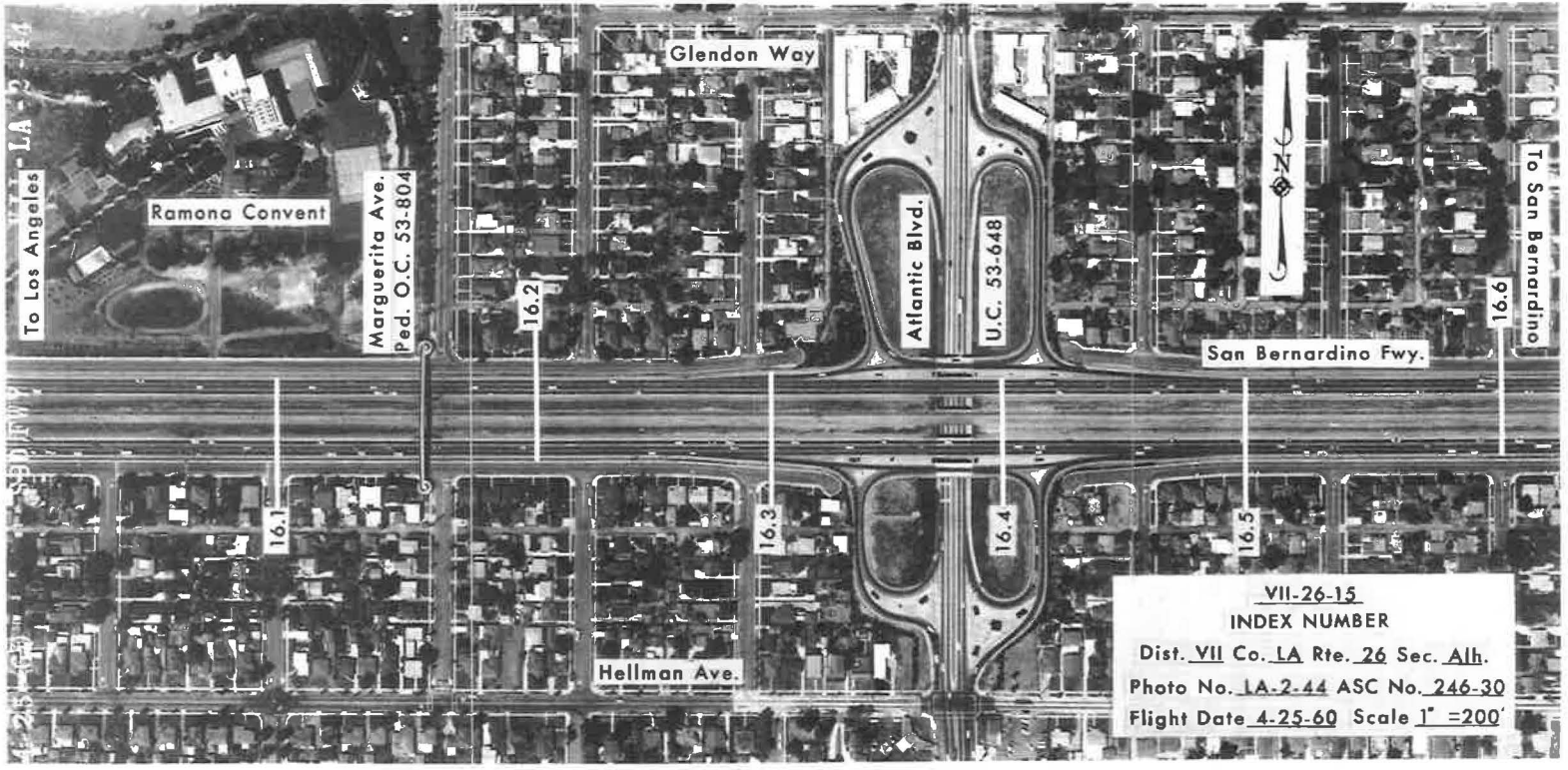

Figure 2. Multilith print showing mileposts and other data added for accident locating purposes.

location of individual accidents. Two highway sections totaling approximately 50 miles of Interstate 80 between San Francisco and Auburn are being used as a pilot study. (This is in conjunction with a major research project being conducted by several States in cooperation with the Bureau of Public Roads to relate accident rates to freeway geometric design details.) Multilith prints of the photographs are furnished to the California Highway Patrol. A copy is attached to each accident report by the officer after he indicates the location and the type of accident on the print. (Ozalid prints from screened film positives of the contact prints are also being used to outline and codify the various areas and interchange segments used in the study.)

The multilith prints were made from screen-process copy negatives of the semi-matte photograph originals. The prints are relatively inexpensive. In quantities of 100 or more the cost is approximately three cents each. Before making the multilith masters, identifying prominent landmarks, cross streets, milepost points, north arrows, and directions to nearest towns are added to the photographs (Fig. 2). The accident location can then be quickly obtained using a transparent variable overlay scale (Figs. 3 and 4). (An ordinary scale cannot be used since the photograph scale is not necessarily 200 ft to 1 in.; varies from photograph to photograph; and varies within a photograph due to camera tilt, ground slope, relief, etc.) This special scale should replace the longer, more costly method of computing distances between mileposts using distances measured between physical objects and recorded in the report by the officer. Thus far, however, sufficient experience has not been had with this application to determine if it will be as timesaving a device as expected. Also, there is evidence the patrolmen are having difficulty in site positioning the accidents accurately on the photographs.

There has been some demand by the users to increase the scale,

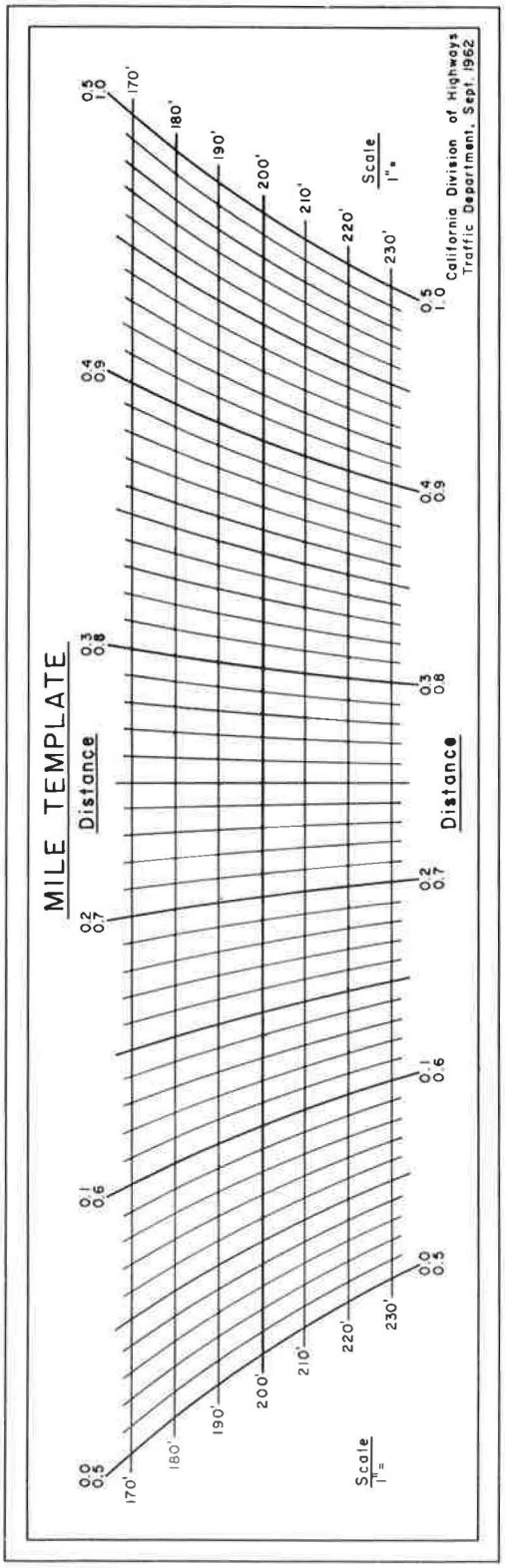

Figure 3. Transparent variable overlay scale.

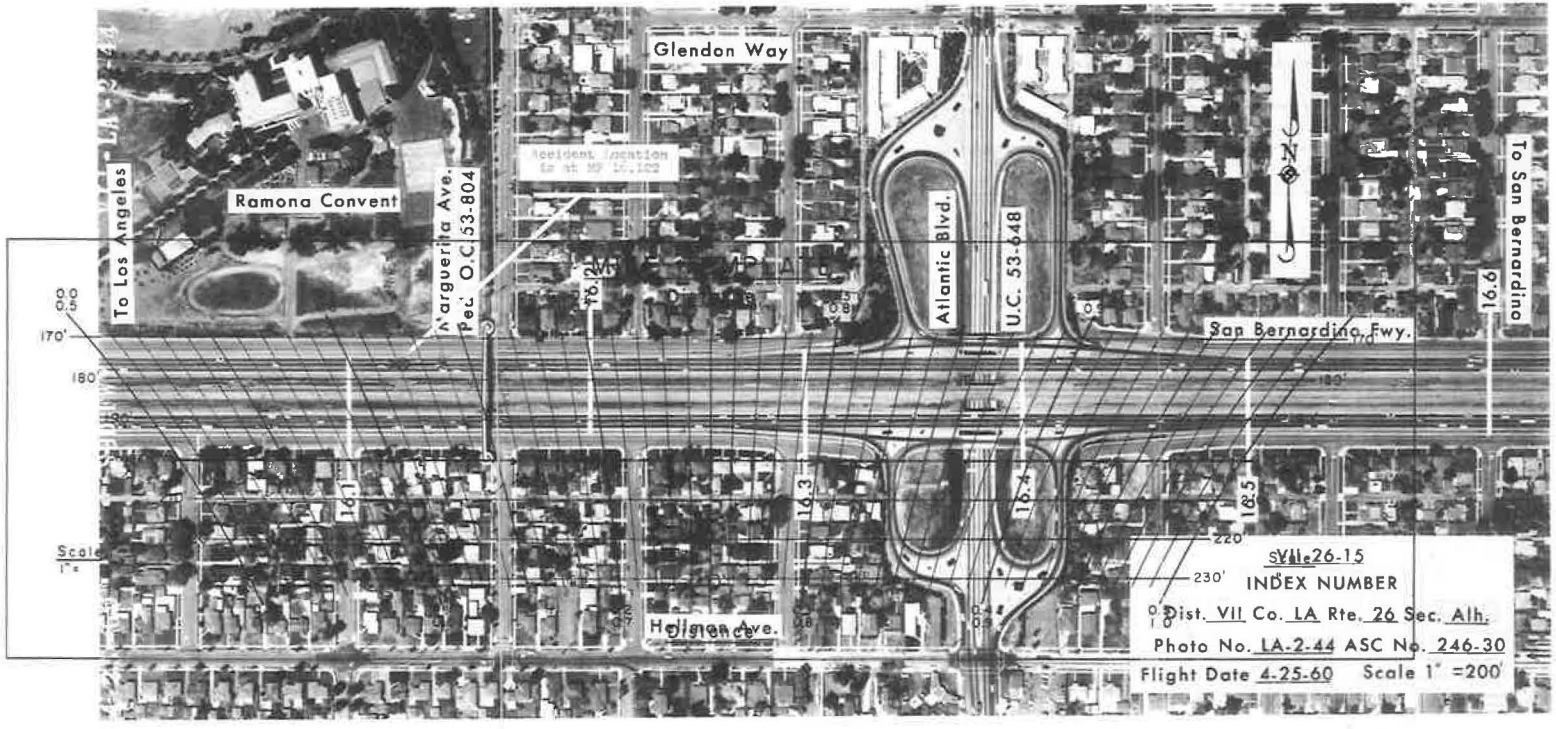

Figure 4. Determining accident locations with overlay scale.

obtain wider coverage, and extend coverage to all major highways (conventional highways as well as freeways). Increasing the scale to 100 ft per in. would increase costs approximately 75 percent. The cost of eliminating scale variations caused by ground relief and tilt of the photographs would be prohibitive. It is felt neither the larger scale nor a more accurate scale is necessary for the general applications made of these photographs.

Such photography coverage will be extended in the near future to all freeways in the State and this coverage will be maintained on a current basis by annually photographing improved, modified, and new sections of freeways.

SUMMARY

The aerial photography inventory has been used extensively and enthusiastically for a wide variety of purposes. These applications include the fields of traffic engineering, research, planning, design, maintenance, and public relations.

Such uses of the photographs have resulted in increased productivity at decreased costs.